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G1G GPKA
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GB 2225933 A GB 1396398 A US 4942640 A
US 4680827 A

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INT CL^{5} **A47L 9/28 , G01F 1/76**
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(54) **Controlling the speed of a vacuum cleaner motor in dependence on the degree of soiling of the treated surface**

(57) A housing (1) conducting the airstream (9) containing the intaken particles is provided with an angle-including entry conduit (4) and exit conduit (5) and with a baffle plate (6) between them to deflect the particle flow. A measuring microphone (20, 21) serves to detect the noise generated by the rebounding particles. A compensation microphone (20) is coupled to the housing (1) to deliver a noise signal as data in respect of the noise from the equipment in order to blank the same out of the microphone signal. By means of an electronic circuit arrangement the microphone signals delivered by the measuring microphone (20, 21) are converted to control signals to control the speed of the fan motor (M). In this way the general noise level which would otherwise be much too high due to improper operation, can be greatly reduced.

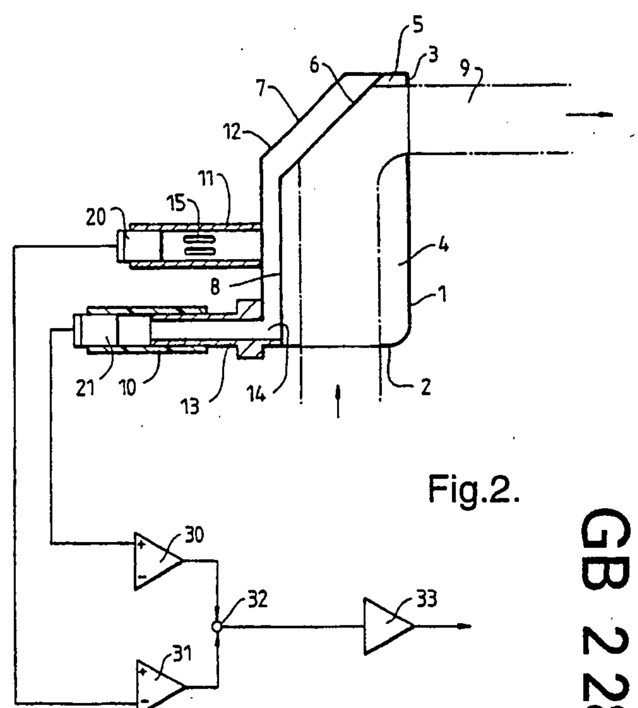

Fig.2.

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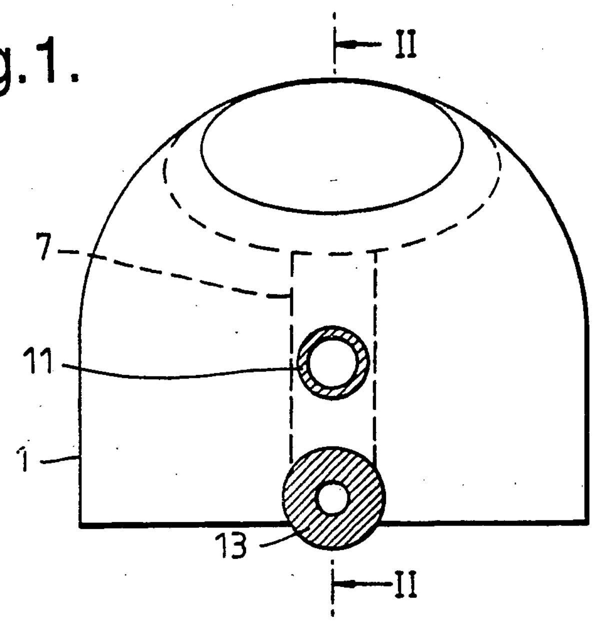
At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.



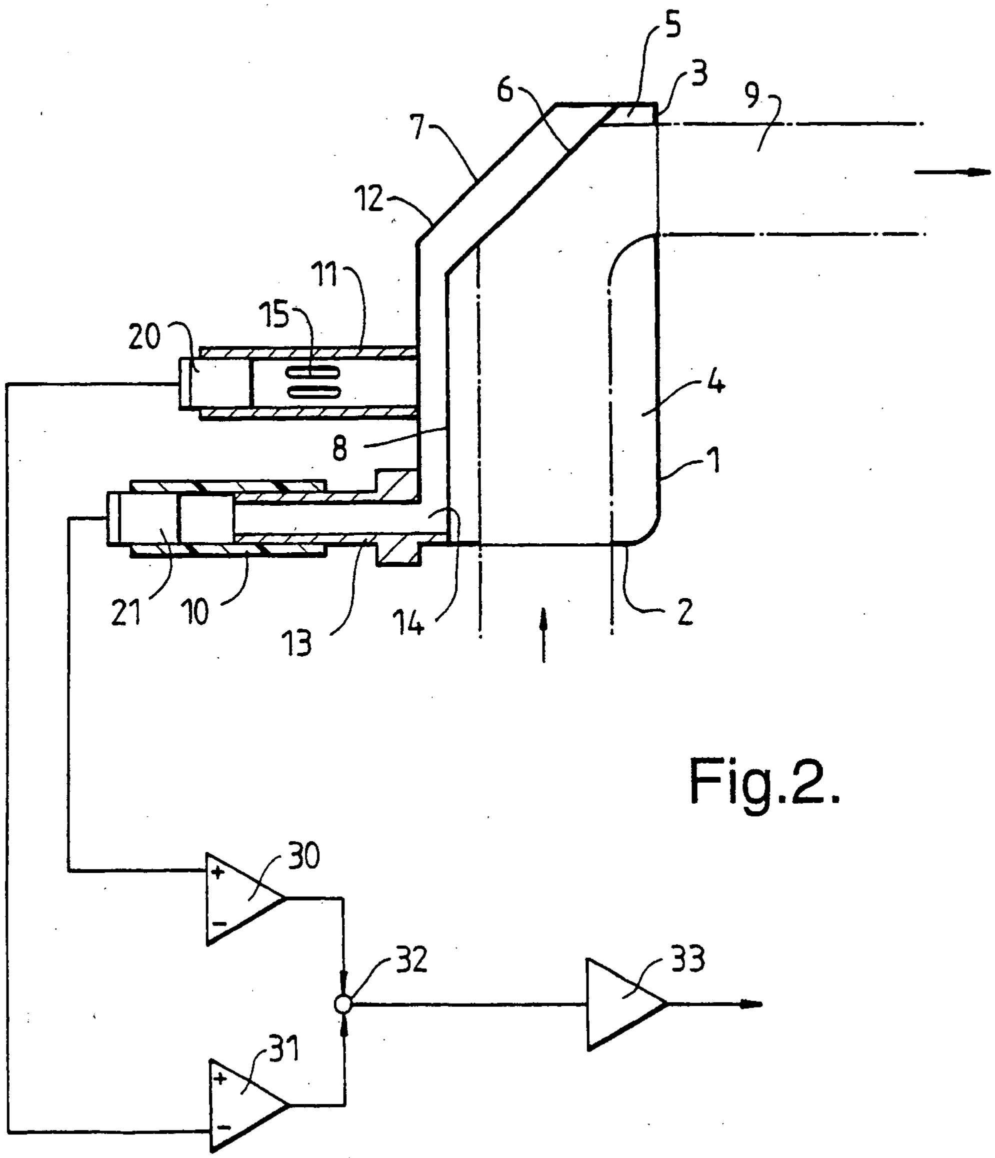
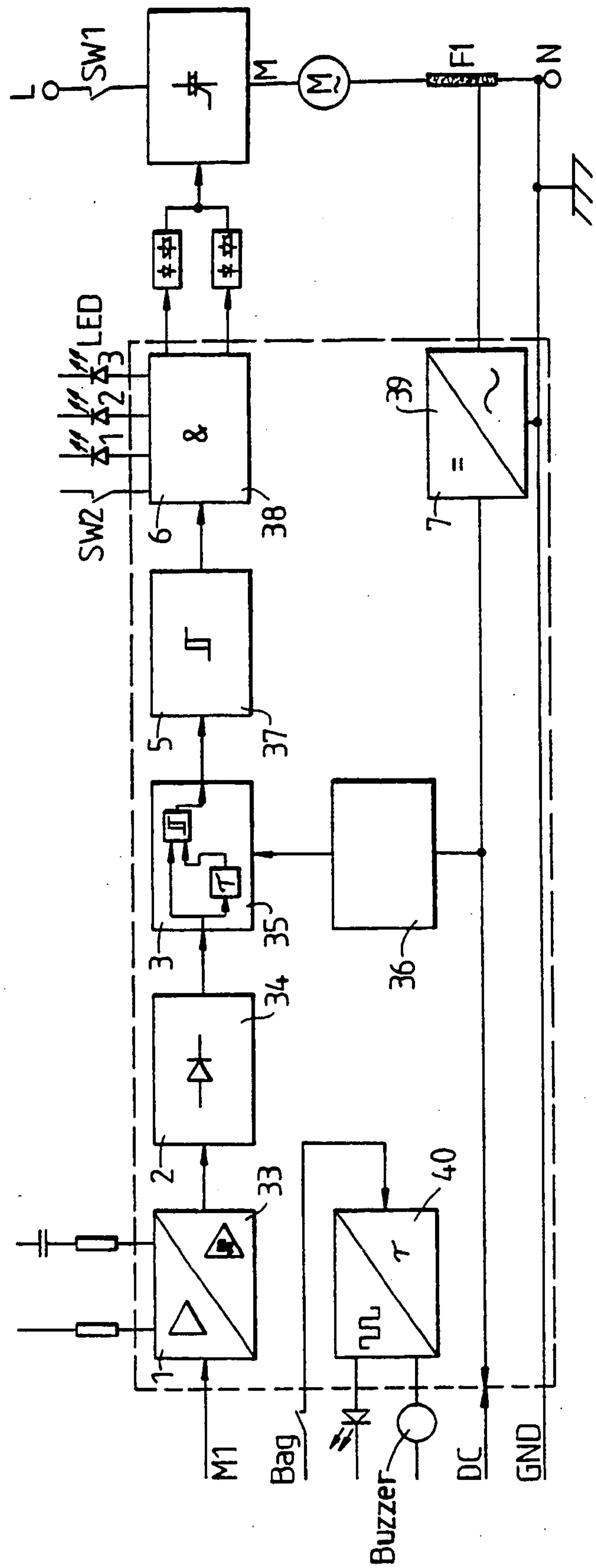


Fig.2.


L
SW1
M
F1
N
LED
1
2
3
SW2
&
6
38
39
7
=
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37
5
35
3
36
34
2
33
40
1
M1
Bag
Buzzer
DC
GND

Fig.3.

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PATENTS ACT 1977

Agents' Reference: P9254GB-H/JCC/ac

DESCRIPTION OF INVENTION

Title: "An arrangement for controlling the speed of a vacuum cleaner motor in dependence on the degree of soiling of the treated surface"

THIS INVENTION relates to an arrangement for controlling the speed of the fan motor of a vacuum cleaner in dependence on the degree of soiling of the treated surface.

It is generally known that vacuum cleaners are operated at too high a speed by users even when the speed is adjustable, and this results in a high noise level which is found disturbing. Steps to reduce noise by mechanical attenuation are possible only to a restricted degree, because there is no space for this, since here too the trend is towards compact, small and handy devices. Electrical steps are known whereby the user can reduce the suction capacity by adjusting the motor speed, so that noise generation is also reduced. Since, however, various degrees of soiling may occur in the home at different places in one and the same room, the user does not correct the suction capacity but usually operates with the maximum suction capacity.

Automatic control would be possible if it were possible to determine the accumulation of dust particles in order thus to control the speed as required.

Accordingly, it is an object of the invention to provide a motor speed control which automatically controls the fan motor speed in dependence on the dust particle accumulation.

According to the invention, there is provided an arrangement for controlling the speed of the fan motor of a vacuum cleaner in dependence of the degree of soiling of the treated surface, wherein there is provided a housing conveying the airstream with the intaken particles, the housing containing an angle-including entry conduit and exit conduit and with a baffle plate between them and deflecting the particle flow, and also at least one measuring microphone to detect the noise generated by the rebounding particles, and an electronic circuit arrangement for converting the microphone signals delivered by the measuring microphone into control signals for controlling the speed of the fan motor.

An arrangement of this kind can detect the particle rebound noise on the baffle plate, but a compensation circuit is required to compensate for the surrounding noise, i.e. the motor noise and airstream noise. An electronic circuit arrangement for the purpose would, however, be very complex and therefore expensive. Accordingly, in a preferred embodiment of the invention, to compensate for the surrounding noise a compensation microphone is provided on the housing to deliver a noise signal as data in respect of the noise produced by the equipment in order to blank the same out of the microphone signal.

One exemplified embodiment of the invention is explained below with reference to the drawing wherein:

FIGURE 1 shows a closed housing forming part of a vacuum cleaner embodying the invention, the housing providing a dust particle passage and two microphones;

FIGURE 2 is a section on the line II-II in Fig. 1 and

FIGURE 3 is a block schematic diagram of an electronic circuit arrangement for measuring the accumulation of dust particles.

An arrangement embodying the invention is shown in Figures 1 and 2. A housing 1 is provided with an intake aperture 2 and an exit aperture 3, and an air passage extending from the intake aperture 2 to the exit aperture 3. This air passage includes an entry conduit 4 leading from intake aperture 2, an exit conduit 5 leading to exit aperture 3 and an intermediate section between the entry conduit and exit conduit. One side of this intermediate section is defined by a baffle plate 6 which is continuous with a wall 8 of the entry conduit 4. The wall 8 and baffle plate 6 define, with an outer wall 12 of the housing, a cavity 7.

The housing 1 forms part of a vacuum cleaner (the remainder not shown), the arrangement being such that the air passage referred to forms part of the passage through which the stream of dust-laden air, drawn into the cleaner by the fan (not shown), must pass to reach the conventional dust receptacle (not shown).

Two hollow spigots 10 and 11 are disposed on the outside of housing 1, adjacent one another. Spigot 11 is secured at one end to the wall 12 and is closed, at that end, by wall 12. Spigot 10, on the other hand, is fitted over an adapter tube 13 which extends from a recess 14 in the housing wall 12. The interior of adaptor tube 13 and thus the interior of spigot 11, communicates with the cavity 7. The spigot 11 is provided with axial slots 15.

A microphone 20 is inserted in the end of the spigot 11 remote from wall 12 and a corresponding microphone 21 is inserted in the end of spigot 10 remote from wall 12.

With this arrangement, the airstream 9 containing the particles of dirt sucked in by the vacuum cleaner fan are thrown from the entry conduit 4 against the baffle plate 6 and, since the latter is inclined at an angle of 45° to the entry conduit 4, the airstream 9 is deflected by the baffle plate 6 to the exit conduit 5 through an angle of 90° relatively to the entry conduit. The dirt particles generate a noise by impinging on the baffle wall 6, such noise varying in volume depending on the particle accumulation, i.e. depending upon the particle content of the airstream 9.

The last-noted noise is picked up by the measuring microphone 21, the spigot 13 of which leads into the cavity 7, and converted into electrical signals. However, this noise includes not only the noise originating from the particles rebounding on the baffle wall, but also the surrounding noise, such as the motor noise and airstream noise.

To compensate for these unwanted surrounding noises a compensation microphone 20 is provided, which picks up practically no noise from the particles but only picks up the surrounding noise referred to, conducted through the housing 1.

The signals from the measuring microphone 21 are fed to the non-inverting input of an operational amplifier 30 and the signals from the compensation microphone 21 are fed to the inverting input of an operational amplifier 31. The now phase-inverted output signals of the compensation

microphone 20 cancel out the surrounding noise components of the microphone signal. Thus only the noise signals from the particles rebounding from the baffle wall are fed to the amplifier 33.

Figure 3 shows a circuit arrangement for evaluating the noise signals. The noise signal is amplified and its amplitude limited in the amplifier 33. As is shown, the amplification factor and the frequency response of amplifier 33 are adjustable. The output signal from the amplifier is rectified at 34 and fed to an automatic follow-up switching threshold stage 35. The follow-up is delayed. With this automatic adaptation the loud surrounding noise from the motor can be compensated within very wide limits. When the vacuum cleaner is switched on, an increased speed will be preset for a short time, e.g. 6 to 10 seconds. This effect is achieved by the time network 36. The following logic stage 38 is triggered via the switching stage 37.

The logic stage 38 controls the motor speed and hence the suction capacity of the vacuum cleaner in dependence on the degree of soiling of the floor surface. The minimum phase angle is first preset. This is indicated optically by the LED 1 with a green light. If the instantaneous switching threshold is exceeded in the above-described block 35, or if the initial switching delay 36 is still operative, an average phase angle is set and the motor rotates at a higher speed. This is indicated by the LED 2 with a yellow light. When the switch SW2 is actuated, the motor is run at full phase and rotates at full speed. This is indicated by LED 3 with a red light.

The power supply is from a tapping of the field winding of the motor, so that a 12 V AC is available and is

rectified in block 39 and is then available for the supply to the electronic components.

The degree of filling of the vacuum cleaner bag can be identified by a bag switch. If this switch closes, it means that the vacuum cleaner bag is full. The circuit stage τ fixes a specific time during which a pulsed current triggers an LED and at the same time operates a buzzer. Resetting is effected only when the mains supply is switched off.

Of course other circuit arrangements are possible to embody the invention. Preferably such other circuit arrangements will incorporate a similar arrangement of two microphones 20, 21 which give data which enable the vacuum cleaner motor to be controlled in dependence on the dirt accumulation. The proposed arrangement of the two microphones in close proximity means that any possible phase error of the surrounding noise is kept very low. Instead of the two microphones 20, 21 disposed close together and each intended to pick up a different noise, it would be possible to couple the two microphones in the cavity 7 so that the two microphones 20, 21 pick up the same noise. If care is taken to ensure that the two microphones are spaced apart by an amount such that an identifiable phase shift of the two signals is present, the signals, the transit times of which are staggered, cannot compensate one another by addition and deliver information which can be evaluated.

CLAIMS

1. An arrangement for controlling the speed of the fan motor of a vacuum cleaner in dependence on the degree of soiling of the treated surface, characterised by a housing (1) conveying the airstream (9) with the intaken particles, the housing containing an angle-including entry conduit (4) and exit conduit (5) and with a baffle plate (6) between them and deflecting the particle flow, and also characterised by at least one measuring microphone (20, 21) to detect the noise generated by the rebounding particles, and characterised by an electronic circuit arrangement (Fig. 3) for converting the microphone signals delivered by the measuring microphone (20, 21) into control signals for controlling the speed of the fan motor (M).

2. An arrangement according to claim 1, characterised by at least one compensation microphone (20) on the housing (1) to deliver a noise signal as data in respect of the noise produced by the equipment in order to blank the same out of the microphone signal.

3. An arrangement according to claim 1 or 2, characterised in that the baffle plate (6) is connected to a wall and together with the latter defines on all sides a cavity (7) adjacent the particle flow (9).

4. An arrangement according to claim 3, characterised in that the measuring microphone (21) is coupled to the cavity (7) by a hollow tubular spigot (13) and a noise-attenuating tube (10).

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) 9	Application number GB 9417212.9
Relevant Technical Fields (i) UK Cl (Ed.M) A4F; G1G (GPKA) (ii) Int Cl (Ed.5) A47L 9/28, G01F 1/76	Search Examiner A C Howard Date of completion of Search 28 September 1994
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES : EDOC	Documents considered relevant following a search in respect of Claims :- 1-7, 9

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X,Y	GB 2225933	(HOOVER) see page 12 line 8 - page 13 line 16	X:1 Y:3
Y	GB 1396398	(DE BREY) see page 1 lines 55-81	1,3
Y	US 4942640	(HAYASHI et al) see column 1 lines 42-47	1,3
Y	US 4680827	(HUMMEL) whole document relevant	1,3

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journ (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

5. An arrangement according to claim 4, characterised in that the compensation microphone (20) is rigidly connected to the housing (1).

6. An arrangement according to any one of claims 1 to 5, characterised in that the signal from the measuring microphone (21) and the signal from the compensation microphone (20) are each first fed to a phase inverter (30, 31) and then to a signal adder (32) in order to remove the surrounding noise from the signal from the measuring microphone (21).

7. An arrangement according to claim 6, characterised in that a tubular spigot (11) carrying the compensation microphone (20) is provided with slots (15) in the tube wall in order to pick up noise from outside the housing.

8. An arrangement according to claim 1 and substantially as hereinbefore described with reference to the accompanying drawings.

9. A vacuum cleaner incorporating an arrangement according to any preceding claim.

10. Any novel feature or combination of features described herein.